- Photo #1 – Placing the bituminous geomembrane with a geotextile under.

- Photo #2 – Reparation of hole in the bituminous geomembrane.

Par : _____
Michaël Racine, tech.

_____
Richard Marcoux, ing.
No OIQ : 38724
Project manager

AGNICO EAGLE

**RAPPORT DE VISITE DE CHANTIER**

STAVIBEL

| | | | |
|---|---|---|---|
| Title of project : | Baker Lake Jet-A Fuel Farm | Date : 2013-07-27 | |
| Project # : | OP-84541-J /VD3356 | Doc #: | VD3356-003-RV-14 |
| Prepared by : | Michaël Racine | Contractor : | Fernand Gilbert Ltée |
| Verified by : | Richard Marcoux, ing. | Temperature : | 15 à 23ºC Wind : 0 à 10 km/h |

Object : Contractor's schedule (approximative hours)

| **Labour and machinery** | **Company** | **Working hours** |
|---|---|---|
| Shovel CAT 365C L | FGL | 5.5 |
| Shovel CAT 320 | FGL | 0 |
| Bulldozer Komat'su 39px | FGL | 0 |
| Roller compactor Hamm 3625 | FGL | 0 |
| Operator | FGL | 12 |
| Surveyor | FGL | 12 |
| 3 Labours | FGL | 4 |
| Generator 6000 W | BLCS | 1 jour |
| Truck Cat 740 | BLCS | 55.2 m3 |
| 2 membrane installers | Texel | 6.5 |
| Field inspector | Stavibel | 12 |

- **6h30 à 12h** Shovel 365 et 2 labours (Texcel) place the bituminous geomembrane.
- **6h30 à 10h30** 3 labours (FGL) place the bituminous geomembrane.
- **13h à 15h** 2 labours (Texcel) test the resistance of the welds in the bituminous geomembrane.
- **13h à 18h30** Operator and surveyor (FGL) stand by.
- **17h à 18h30** Truck CAT 740 hauls the 0-20mm crushed stone.

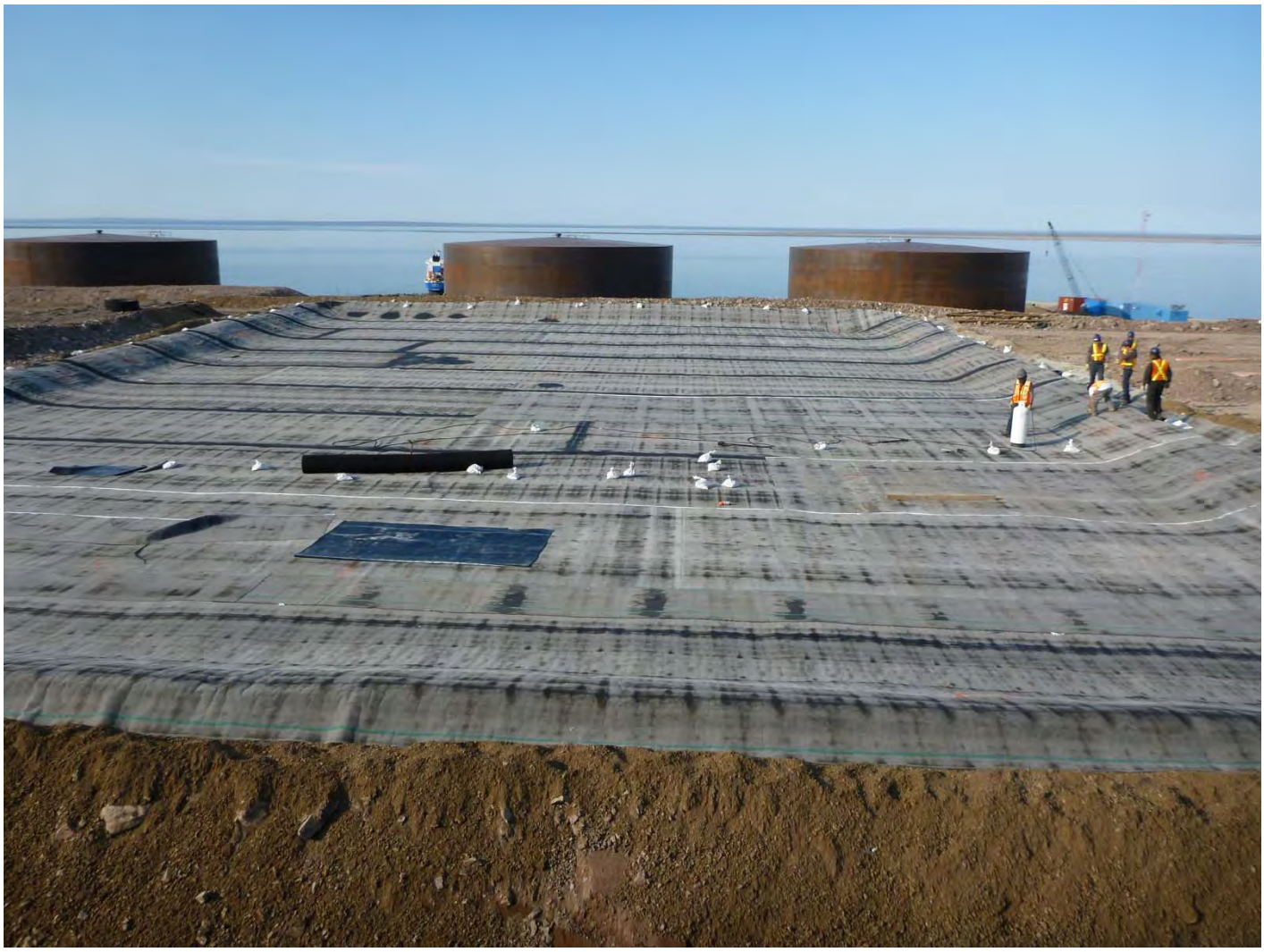
**Comments :**

- Inspection of the membrane.
- The 0-20 mm crushed stone produce by BLCS for the pad above the bituminous geomembrane is non- compliant. It contains particules up to 1-1/2". The material is rescreened and the placing of the 0-20 mm crushed stone begins at the end of the day.
- I inspect the membrane before filling above to make sure that no hole and no punching remains. Small rocks are detected under the membrane. Pieces of membrane are added on it.

- Survey of a load of 0-20 mm crushed stone. The result is 18.4 m3/load. Here are the corrected quantities according to this new volume:

| | 0-3/4" | | Muck quarry 1 | |
|---|---|---|---|---|
| | load | volume (m3) | load | volume (m3) |
| **2013-07-15** | | | 24 | 441,6 |
| **2013-07-16** | | | 34 | 625,6 |
| **2013-07-17** | 15 | 276 | 14 | 257,6 |
| **2013-07-20** | 7 | 128,8 | | |
| **2013-07-21** | 3 | 55,2 | | |
| **2013-07-23** | 2 | 36,8 | | |
| **2013-07-27** | 3 | 55,2 | | |
| **Cumulative** | 30 | **552** | 72 | **1324,8** |

- Photo #1 – Installing the bituminous geomembrane with a geotextile under.



- Photo #2 – Sampling of Colétanche in place to test the welds resistance with the tensometer. The results are compliant according to the Texel membrane installers.

- Photo #3 – Inspection of the membrane. Small proeminent rocks (10mm and less) are detected at some place under the membrane. A second tickness of colétanche is added on these spots to make sure there will not be any punching.

Par : _____
Michaël Racine, tech.

_____
Richard Marcoux, ing.
No OIQ : 38724
Project manager

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# RAPPORT DE VISITE DE CHANTIER

STAVIBEL

| | | | |
|---|---|---|---|
| Title of project : | Baker Lake Jet-A Fuel Farm | Date : 2013-07-28 | |
| Project # : | OP-84541-J /VD3356 | Doc #: | VD3356-003-RV-15 |
| Prepared by : | Michaël Racine | Contractor : | Fernand Gilbert Ltée |
| Verified by : | Richard Marcoux, ing. | Temperature : | 15 à 23ºC Wind : 0 à 10 km/h |

Object : Contractor's schedule (approximative hours)

| **Labour and machinery** | **Company** | **Working hours** |
|---|---|---|
| Shovel CAT 365C L | FGL | 8 |
| Shovel CAT 320 | FGL | 0 |
| Bulldozer Komat'su 39px | FGL | 2 |
| Roller compactor Hamm 3625 | FGL | 0 |
| Operator | FGL | 12 |
| Surveyor | FGL | 12 |
| Truck Cat 740 | BLCS | 239.2 m3 |
| Shovel Cat 307 | AEM | 1 |
| Field inspector | Stavibel | 12 |

- **6h30 à 18h30** Shovel 365, Shovel 320 et Bulldozer 39px (alternating) place the 0-20mm crushed stone on the bituminous geomembrane.
- **8h à 18h30** Truck CAT 740 hauls the 0-20mm crushed stone.

**Comments :**

- After comparison of the specs of the shovel CAT 307 and the bulldozer Komat'su 39px, we decide to use the bulldozer instead of the shovel 307. The ground pressure is 33.34 kPa (with the bulldozer) instead of 32.3 kPa (with the shovel).
- Big waiting time for the BLCS material. Only 1 truck. Around 2 loads/hour.

- Summary of the volumes hauled by BLCS (18.4 $m^3$/load) :

| | 0-3/4" | | Muck quarry 1 | |
|---|---|---|---|---|
| | load | volume (m3) | load | volume (m3) |
| **2013-07-15** | | | 24 | 441,6 |
| **2013-07-16** | | | 34 | 625,6 |
| **2013-07-17** | 15 | 276 | 14 | 257,6 |
| **2013-07-20** | 7 | 128,8 | | |
| **2013-07-21** | 3 | 55,2 | | |
| **2013-07-23** | 2 | 36,8 | | |
| **2013-07-27** | 3 | 55,2 | | |
| **2013-07-28** | 13 | 239,2 | | |
| **Cumulative** | 43 | **791,2** | 72 | **1324,8** |

- Photo #1 – Sreening of the 0-20mm and loading of the trucks at the Nuna Pad (BLCS).

- Photo #2 – Placing the 0-20mm above the bituminous geomembrane. A geotextile is place before.

Par : _____
Michaël Racine, tech.

_____
Richard Marcoux, ing.
No OIQ : 38724
Project manager

AGNICO EAGLE

# RAPPORT DE VISITE DE CHANTIER

STAVIBEL

| | | | |
|---|---|---|---|
| Title of project : | Baker Lake Jet-A Fuel Farm | Date : 2013-07-29 | |
| Project # : | OP-84541-J /VD3356 | Doc #: | VD3356-003-RV-16 |
| Prepared by : | Michaël Racine | Contractor : | Fernand Gilbert Ltée |
| Verified by : | Richard Marcoux, ing. | Temperature : | 15 à 17ºC Wind : 20 à 30 km/h |

Object : Contractor's schedule (approximative hours)

| **Labour and machinery** | **Company** | **Working hours** |
|---|---|---|
| Shovel CAT 365C L | FGL | 7.5 |
| Shovel CAT 320 | FGL | 0 |
| Bulldozer Komat'su 39px | FGL | 3.5 |
| Rolle compactor Hamm 3625 | FGL | 0 |
| Operator | FGL | 12 |
| Surveyor | FGL | 12 |
| Truck Cat 740 | BLCS | 257.6 m3 |
| Shovel Cat 307 | AEM | 0 |
| Field inspector | Stavibel | 12 |

- **6h30 à 18h30** Shovel 365 et Bulldozer 39px (alterning) place the 0-20mm on the bituminous geomembrane.
- **7h à 18h30** Camion CAT 740 hauls the 0-20mm.

**Comments :**

- Big waiting time for the BLCS material. Only 1 truck. About 40 minutes between loads.
- The BLCS crusher is out of use. The 0-20mm will be make entirely by the screener.

- Summary of the volumes hauled by BLCS (18.4 $m^3$/load) :

| | 0-3/4" | | Muck quarry 1 | |
|---|---|---|---|---|
| | load | volume (m3) | load | volume (m3) |
| **2013-07-15** | | | 24 | 441,6 |
| **2013-07-16** | | | 34 | 625,6 |
| **2013-07-17** | 15 | 276 | 14 | 257,6 |
| **2013-07-20** | 7 | 128,8 | | |
| **2013-07-21** | 3 | 55,2 | | |
| **2013-07-23** | 2 | 36,8 | | |
| **2013-07-27** | 3 | 55,2 | | |
| **2013-07-28** | 13 | 239,2 | | |
| **2013-07-29** | 14 | 257,6 | | |
| **Cumulative** | 57 | **1048,8** | 72 | **1324,8** |

- Photo #1 – Lot of particules bigger than 20mm in the 0-20mm brought by BLCS. We advise BLCS to check the sreener. Indeed, there was a gap on the side of the sreen because of a missing inner bar. After the reparation of the screener, there is still presence of particules up to 100mm in the material from an unknow source. We remove them by hand on the field, but there is still a lot of rocks around 1 1/2" big.

- Photo #2 – Placing the 0-20mm above the bituminous geomembrane. A geotextile is placed before.

Par : _____
Michaël Racine, tech.

_____
Richard Marcoux, ing.
No OIQ : 38724
Project manager

AGNICO EAGLE

# RAPPORT DE VISITE DE CHANTIER

STAVIBEL

| | | | |
|---|---|---|---|
| Title of project : | Baker Lake Jet-A Fuel Farm | Date : 2013-07-30 | |
| Project # : | OP-84541-J /VD3356 | Doc #: | VD3356-003-RV-17 |
| Prepared by : | Michaël Racine | Contractor : | Fernand Gilbert Ltée |
| Verified by : | Richard Marcoux, ing. | Temperature : | 15 à 17ºC Wind : 20 à 30 km/h |

Object : Contractor's schedule (approximative hours)

| **Labour and machinery** | **Company** | **Working hours** |
|---|---|---|
| Shovel CAT 365C L | FGL | 7 |
| Shovel CAT 320 | FGL | 0 |
| Bulldozer Komat'su 39px | FGL | 4 |
| Roller compactor Hamm 3625 | FGL | 0 |
| Operator | FGL | 12 |
| Surveyor | FGL | 12 |
| Truck Cat 740 | BLCS | 202.4 m3 |
| Shovel Cat 307 | AEM | 0 |
| Field inspector | Stavibel | 12 |

- **6h30 à 18h30** Shovel 365 and Bulldozer 39px (alterning) place the 0-20mm on the bituminous geomembrane.
- **8h à 18h00** Truck CAT 740 hauls the 0-20mm.

**Comments :**

- Big waiting time for the BLCS material. Only 1 truck. About 40 minutes between loads.
- The BLCS crusher is out of use. The 0-20mm will be make entirely by the screener.
- Taking of 2 samples of 0-20mm on the field and 1 more sample in the BLSC stockpile at the Nuna Pad.

- Summary of the volumes hauled by BLCS (18.4 $m^3$/load) :

| | 0-3/4" | | Muck quarry 1 | |
|---|---|---|---|---|
| | load | volume (m3) | load | volume (m3) |
| **2013-07-15** | | | 24 | 441,6 |
| **2013-07-16** | | | 34 | 625,6 |
| **2013-07-17** | 15 | 276 | 14 | 257,6 |
| **2013-07-20** | 7 | 128,8 | | |
| **2013-07-21** | 3 | 55,2 | | |
| **2013-07-23** | 2 | 36,8 | | |
| **2013-07-27** | 3 | 55,2 | | |
| **2013-07-28** | 13 | 239,2 | | |
| **2013-07-29** | 14 | 257,6 | | |
| **2013-07-30** | 11 | 202,4 | | |
| **Cumulative** | 68 | **1251,2** | 72 | **1324,8** |

- Photo #1 – I mesured the mesh size of the BLCS screener. The opening of 30mm explain the presence of particules higher than 20 mm. BLCS affirmed that they don't have a smaller screen on July 27th when they change the screen. Also, there is still several rocks up to 100 mm in the 0-20 mm. We remove them by hand on the field.

- Photo #2 – Placing the 0-20mm above the bituminous geomembrane. A geotextile is placed before.

- Photo #3 – Compaction test with the roller compacter Hamm 3625 on low vibration directly on the 0-20mm uncompacted and without any covering above. Not any hole nor any deformation are noticed on the bituminous geomembrane. The decision is taken to use the roller compactor for the compaction of the pad above the Colétanche membrane.

Par : _____
Michaël Racine, tech.

_____
Richard Marcoux, ing.
No OIQ : 38724
Project manager

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# RAPPORT DE VISITE DE CHANTIER

STAVIBEL

| | | | |
|---|---|---|---|
| Title of project : | Baker Lake Jet-A Fuel Farm | Date : 2013-07-31 | |
| Project # : | OP-84541-J /VD3356 | Doc #: | VD3356-003-RV-18 |
| Prepared by : | Michaël Racine | Contractor : | Fernand Gilbert Ltée |
| Verified by : | Richard Marcoux, ing. | Temperature : | 15 à 17ºC Wind : 20 à 30 km/h |

Object : Contractor's schedule (approximative hours)

| **Labour and machinery** | **Company** | **Working hours** |
|---|---|---|
| Shovel CAT 365C L | FGL | 5 |
| Shovel CAT 320 | FGL | 4.5 |
| Bulldozer Komat'su 39px | FGL | 1.5 |
| Roller compactor Hamm 3625 | FGL | 2 |
| Operator | FGL | 12 |
| Surveyor | FGL | 12 |
| Truck Cat 740 | BLCS | 33.8 m3 |
| Water tanker | Hamlet | 2 |
| Shovel Cat 307 | AEM | 0 |
| Field inspector | Stavibel | 12 |

- **6h30 à 10h** Shovel 365 and Bulldozer 39px (alterning) place the 0-20mm on the bituminous geomembrane.
- **8h30 à 10h30** Water tanker moistens the 0-20mm using a total of 15234 L of water.
- **10h30 à 13h30** Compactor compacts the pad of 0-20mm.
- **10h à 14h** Shovel 365 moves the contaminated stockpile to profile better the ditch.
- **14h à 18h30** Shovel 320 backfills the small key trench for the bituminous geomembrane and installs a steel pipe for the electric wire feeding the pump house..

**Comments :**

- Departure of the field inspector (myself) on August 1st around 7h.

- Survey of 42 loads of 0-20mm in place uncompacted. Here is the summary of the volumes haules by BLCS (estimate with an average of 16.9 $m^3$/load) :

| | 0-3/4" | | Muck quarry 1 | |
|---|---|---|---|---|
| | load | volume (m3) | load | volume (m3) |
| **2013-07-15** | | | 24 | 405,6 |
| **2013-07-16** | | | 34 | 574,6 |
| **2013-07-17** | 15 | 253,5 | 14 | 236,6 |
| **2013-07-20** | 7 | 118,3 | | |
| **2013-07-21** | 3 | 50,7 | | |
| **2013-07-23** | 2 | 33,8 | | |
| **2013-07-27** | 3 | 50,7 | | |
| **2013-07-28** | 13 | 219,7 | | |
| **2013-07-29** | 14 | 236,6 | | |
| **2013-07-30** | 11 | 185,9 | | |
| **2013-07-31** | 2 | 33,8 | | |
| **Cumulative** | 70 | **1183** | 72 | **1216,8** |

- Photo #1 – Moistening and compaction of the 0-20mm. Compaction: 2 static passes, 1 vibratory pass in each direction and 2 last static passes.

- Photo #2 – Installation of a steel pipe with a rope inside in prevision of passing the electric wire to the pump house.

- Photo #3 – Overview of the second containment system ready to take the Jet-A tanks.

Par : _____
Michaël Racine, tech.

_____
Richard Marcoux, ing.
No OIQ : 38724
Project manager

# APPENDIX 3.

## SM'S TECHNICAL DATA SHEETS & DRAWINGS DOCUMENTS.

MECHANICAL PARTS DESCRIPTIONS, PHOTOGRAPH, INSTALLATION AND ELECTRICAL PLANS.

SM CONSTRUCTION INC.

AGNICO EAGLE

Baker Lake

# Technical Data Sheets & Drawings

**SM Construction inc.**
15971, boulevard de la Colline
Québec (Québec) G3G 3A7

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**Established Leaders** in Valve Actuation

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2013-10-30
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Jonathan Faucher — 131007
Nom — N° de membre de l'OIQ

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IQ Pro

# IQ *Pro* Range

**IQ and IQT Multi-turn and Quarter-turn**
Electric Valve Actuators

Publication E110E Issue 09/09

rotork®

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**Rotork actuators have been in use all around the world for over 50 years. In this time Rotork has grown to become the leader in the valve automation industry. With manufacturing, service centres, offices and representatives throughout the world, Rotork is able to offer global service solutions to your company.**

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At the heart of the company is an exceptional workforce - the highly trained, forward-thinking engineers, technicians and support staff who each have a crucial role to play in maintaining Rotork's unrivalled reputation for innovation, reliability and first class customer support.

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rotork® Fluid Systems
rotork® Gears
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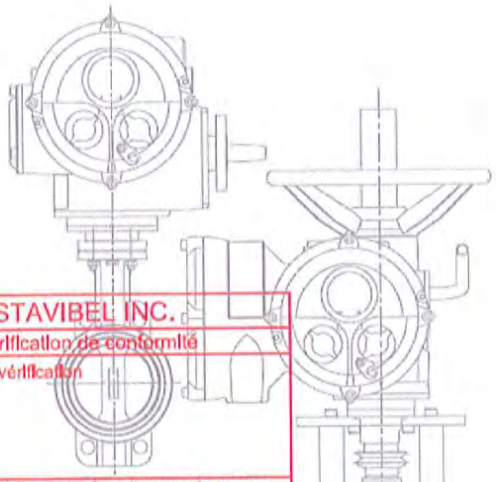

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**This brochure provides a comprehensive overview of the applications and associated functions available with Rotork IQ *Pro* actuators - comprising IQ multi-turn and IQT quarter-turn ranges.**

For information about IQ actuators and explanation of their features see Section 1. For detailed technical specifications and performance data see Section 2.

Launched in 1993, the IQ actuator was the first 'intelligent' non-intrusive actuator available to the valve market. It introduced revolutionary features including the data logging of actuator operation history and an infra-red setting tool replacing traditional mechanical setup.

In 2000 the IQ received a major upgrade with additional control and monitoring features, datalogging, piezo torque measurement technology, improvements in user interface, ergonomics and, corrosion resistance.

The IQT quarter-turn actuator was launched in 2004, encompassing all of the intelligent features of the IQ in a direct quarter-turn actuator.

Building on previous developments, IQ *Pro* brings together IQ and IQT ranges within a single integrated approach with additional common enhancements. These include multilingual text displays that can be uploaded without restriction (other than translation) and currently include Spanish, German, French, Chinese (Mandarin), and Russian. Downloadable of actuator configuration and data log files (using the supplied non-intrusive, intrinsically safe IQ Actuator Setting Tool *Pro)* allows comprehensive asset management and valve & actuator performance monitoring, using the free Windows™ operating system application IQ-Insight.

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## The IQ range

The Rotork IQ delivers a complete range of actuators suitable for all multi-turn valve applications requiring control and indication flexibility. It offers end users ever higher standards of performance, build quality and overall value.

### Simple Commissioning

The Rotork IQ provides simple, safe and rapid non-intrusive commissioning with infra-red control. Actuator settings such as torque levels, position limits, control and indication functions can be accessed and adjusted using the "point and shoot" IQ Setting Tool *Pro*. This supplied, intrinsically safe (IS) tool is unique to Rotork and allows for non-intrusive actuator set-up whatever the environment, power on or off.

### Simple Troubleshooting

The large digital position display clearly indicates real time valve position from a distance. In addition, active valve, control, actuator status and alarm text messages are displayed on the easy to read back-lit display. Using the IQ Setting Tool *Pro* real-time torque against position profiles and actuator configuration can be accessed during commissioning, adjustment or local valve performance monitoring. The onboard data logger records operational, alarm and valve torque profile data providing valuable information on valve and plant operating performance and conditions.

### IQ offers a range of powerful features:

- Three phase, direct current and single phase actuators
- On-board data logger included as standard
- IrDA™ compatible for local and remote actuator analysis via InSight PC software
- Clear, user friendly controls and indication
- Multilingual text display for status and setup
- Simplified torque and position control for increased reliability
- Comprehensive control and flexibility
- Approved for use in SIL applications†

### IQ

IQ actuators are multi-turn electric actuators which can be used for isolation or regulating duties of up to 60 starts per hour. IQ's are watertight or watertight and explosionproof depending upon specification.

Direct torque output range from 34 Nm (25 lbf ft) to 3,000 Nm (2,200 lbf ft).

### IQM

The modulating version of the IQ has a solid state reversing starter in place of the electromechanical contactors. "Hammerblow" lost motion drive is removed and fast response remote control circuits for rapid control are included. The IQM is suitable for up to 1,200 starts per hour. The solid state starter also adds an electronic motor 'brake' feature, improving positional control.

### IQML

Benefiting from all the features of the IQ and IQM actuators, the IQML has a linear output drive providing modulating thrust output of up to 150 kN.

### IQS

IQS actuators are single phase versions of IQ actuators.

Torque range from 65 Nm (48 lbf ft) to 450 Nm (332 lbf ft).

### IQD

IQD actuators are direct current (DC) versions of IQ actuators.

Torque range from 34 Nm (25 lbf ft) to 305 Nm (225 lbf ft).

### IQH

The IQH provides a range of high output speeds while being generally irreversible and therefore providing a self-locking* ability by the actuator for the valve. Developed for diverter valves in meter prover applications, IQH provides fast operation with positive seating without backdriving.

**For detailed information see publication E118E*

### Special Designs

With our extensive product range and engineering knowledge Rotork can provide solutions for most applications.

†with an additional SFCM Control Module

# IQT quarter-turn actuators

## The IQT range

The IQT (IQ quarter-turn) is the result of ongoing commitment to product development at the cutting edge of new technology.

Maintaining the simple commissioning and troubleshooting design of the Rotork IQ (see left), the new IQT introduces a direct drive, quarter turn actuator—offering the highest standards in comprehensive control, access to real time diagnostics and comprehensive bus compatibility.

## IQT features:

- Direct drive quarter-turn
- Three phase, direct current and single phase actuators
- Multilingual text display for status and setup
- On-board data logger included as standard
- IrDA™ compatible for local and remote actuator analysis via InSight PC software
- Clear, user friendly controls and indication
- Simplified torque and position control for increased reliability
- Comprehensive control and flexibility
- Approved for use in SIL applications

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## IQT

IQT actuators are direct drive quarter-turn electric actuators which can be used for isolation or regulating duties of up to 60 starts per hour. IQT's are watertight or watertight and explosionproof depending upon specification.

Torque output from 50 Nm (37 lbf ft) to 2,000 Nm (1,476 lbf ft).

## IQT Fail Safe

The IQT Failsafe actuator provides valve failsafe operation by utilising power from an internal battery during AC supply mains failure. Under normal supply conditions the actuator operates from the site AC electrical supply. On loss of this supply the actuator automatically switches over to receive power from a 24 V DC supply allowing control of the valve to the failsafe position.

*For detailed information see publication E116E*

## IQTM

The modulating version of the IQT has solid state motor switching and includes fast response remote control circuits for rapid response to control signals. The IQTM is suitable for up to 1,200 starts per hour.

## IQTF

The IQTF provides extended output rotation for part turn valve types requiring more than 90° for operation. Typical valves include 180° and 270° diverter valves and multiport manifolds requiring bi-directional 360° operation. The IQTF actuator has a low output speed for increased positional accuracy.

The IQTF may also be utilised for low turn, multiturn applications where slow operation is required.

*For detailed information see publication E119E*

## IQTN

The IQTN has been developed to meet the specialist demands of nautical & military applications within a standard package.

Retaining all the features of the IQT the IQTN has a shorter electronics cover for confined on-board spaces and an anti-shock base.

*For detailed information see publication E1122E*

## Special Designs

With our extensive product range and engineering knowledge Rotork can provide solutions for all applications.

Torque and Position Monitoring

Realtime Monitoring

Actuator Alarms

## *Pro* features

IQ *Pro* combines existing proven Rotork IQ features with additional control and indication functions, improved user interface design, performance monitoring and datalogging - including valve torque signature profiles. This means unparalleled support in achieving reliable valve actuation.

Founded on over 15 years of operational experience, the IQ *Pro* control system combines proven control logic with field programmable technology, thus providing increased functionality and reliability. IQ *Pro* control logic can be upgraded over the IrDA™ interface – this will "future proof" valve operation against control system and actuator developments and upgrades.

In combination with the new non-intrusive, Intrinsically Safe Rotork Setting Tool *Pro*, IQ actuator set-up and datalogger files can be transported from the field to the office for storage and analysis.

## IQ and IQT *Pro* offer a range of powerful features unparalleled in Valve Actuation:

- Field upgradeable control system
- Larger, clearer display
- Customer configurable, multilingual text capability
- Datalogger valve torque signature profiling
- Status & monitoring diagnostics
- Retrofittable to existing IQ & IQT range of actuators (post 2000)
- Improved data download speed x 10

## Setting Tool *Pro* features include:

- Non-intrusive, Infra-red communication
- Intrinsically safe for use in hazardous areas
- On site actuator configuration and data download
- Data transfer from actuator to PC with free Rotork Insight software
- Capacity for 10 configuration and 4 datalogger files
- Multiple configuration capability

Note: Setting Tool *Pro* data transfer capability is compatible only with IQ actuators supplied since 2000.

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## Actuator display

IQ *Pro* incorporates a unique liquid crystal display developed specifically for actuator indication. The unique, diffused LED backlighting system has a top section which indicates valve position and is operational over the full operating temperature range of the actuator. Large segments with backlighting allow clear visibiltiy of valve position in all light conditions.

The lower section shows real time valve, control and actuator status, torque and alarm messaging during operation. Using the Setting Tool changes the display from position mode to set-up mode, allowing the user to view, adjust and change actuator settings.

The LCD display is supplemented with green, yellow and red position indication lights.

The display together with the control cover can be rotated through 90° increments to suit valve orientation and access.

## Indication back up

Rotork recognise the need for local and remote position indication at all times, even when the actuator is powered down. The IQ incorporates a battery to maintain and update position indication when the main power is switched off. The battery also supports data logging and commissioning whilst power is off.

## Set-up

Infra-red set up, adjustment and review using the supplied, intrinsically safe IQ Setting Tool *Pro* gives users access to the configuration of the actuator.

## Help screens

Eight help screens can be accessed with the IQ setting tool allowing real time, grouped analysis of control signal status, valve and actuator status and indication status.

## Valve torque indication

Valve torque against position can be displayed in real time with a single setting tool keystroke. Trip levels set for torque switches can be checked and adjusted based on the actual valve operating torque requirements. This results in a more realistic and accurate set up, therefore reducing the need for future "snagging". Problems such as valve tight-spots, seating and breakout forces can be assessed immediately in the field.

## SIL and high integrity control systems

IQ *Pro* SIL option is available for Safety Instrumented Systems (SIS) requiring a defined Safety Integrity Level 1, 2 or 3*. The TÜV™ certified IQ *Pro* SIL option provides dual redundancy for control operation making safety functions "Stay-put" and "ESD" (IQ range only) available. For more information refer to section 2 - Specifications.

For applications requiring higher integrity but not SIL defined, standard IQ *Pro* can be configured for conditional control.

* SIL3 applications may be met using a 1oo2 actuator configuration

In this mode, operation depends on two discrete signals being applied. As an example of a close valve command, by applying a signal to the remote close input and close conditional input simultaneously the actuator will operate and close the valve. If only one signal is applied, or a signal is lost, the actuators will stayput. For applications requiring ESD, the dedicated ESD input is available with a higher priority over local or remote control signals. This will therefore override any existing or applied control signal while it is applied.

## Asset Management - Data logging

IQ *Pro* allows complete actuator configuration and build information to be downloaded and saved to PC. It also includes a data logger that captures and stores valve, actuator and control system status information in non-volatile memory, including:

- **Valve torque profile** - open/closed instantaneous and average torque profiles plotted against valve stroke. Reference profiles stored during commissioning can be compared to in-service torque profiles for valve performance analysis.
- **Starts log** – open/closed start positions plotted against valve stroke. Allows process control valve operation.
- **Statistics** – number of operations, highest recorded torque, last limit switch operation, battery run time, battery voltage.
- **Monitor log** – control system, actuator and indication event log, can be replayed and filtered for events of interest such as "torque trip". The last 1024 events are stored and stamped with date and time.

Using the IQ *Pro* IrDA™ interface, datalogger files can be downloaded to the IQ *Pro* tool or PDA running freeware IQ Pocket Insight for uploading to PC. IQ Insight PC based software is described in detail on page 12.

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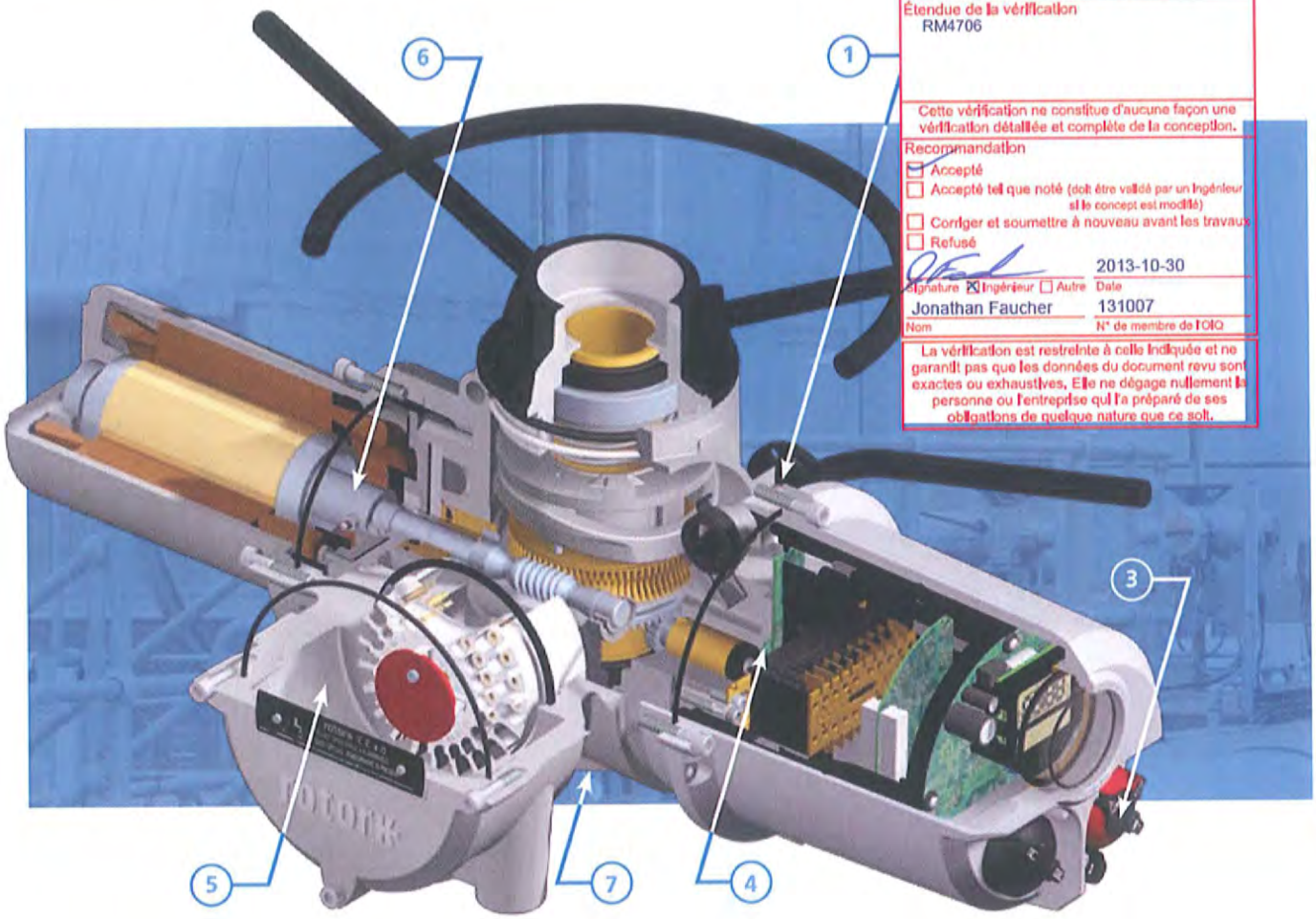


### 1 Hand operation

Direct drive handwheel (or geared handwheel on larger sizes and IQT) provides reliable emergency manual operation in the event of a power supply failure. Includes padlockable* hand/auto clutch for safe operation even when the motor is running.

Note: power operation always has preference unless hand/auto lever is purposely locked into 'hand drive'. Lost motion 'hammerblow' effect is provided with both direct and independently geared handwheels.

### 2 Non intrusive setting

All actuator settings and diagnostics are made through the sealed indication window using IrDA™ communication. It is not necessary to remove electrical covers which would expose the integral controls to the plant environment.

### 3 Local controls

Local controls and padlockable* Local/Stop/Remote selector switch operate internal reed switches, avoiding penetrating shafts which would have to be sealed to prevent moisture ingress.

### 4 Position control

Hall effect magnetic pulse system accurately measures and controls the stroke of the actuator without using gears and switches.

### 5 Terminal compartment

Separately sealed terminal compartment ensures the integrity of the electrical equipment even when the terminal cover is removed during on-site wiring.

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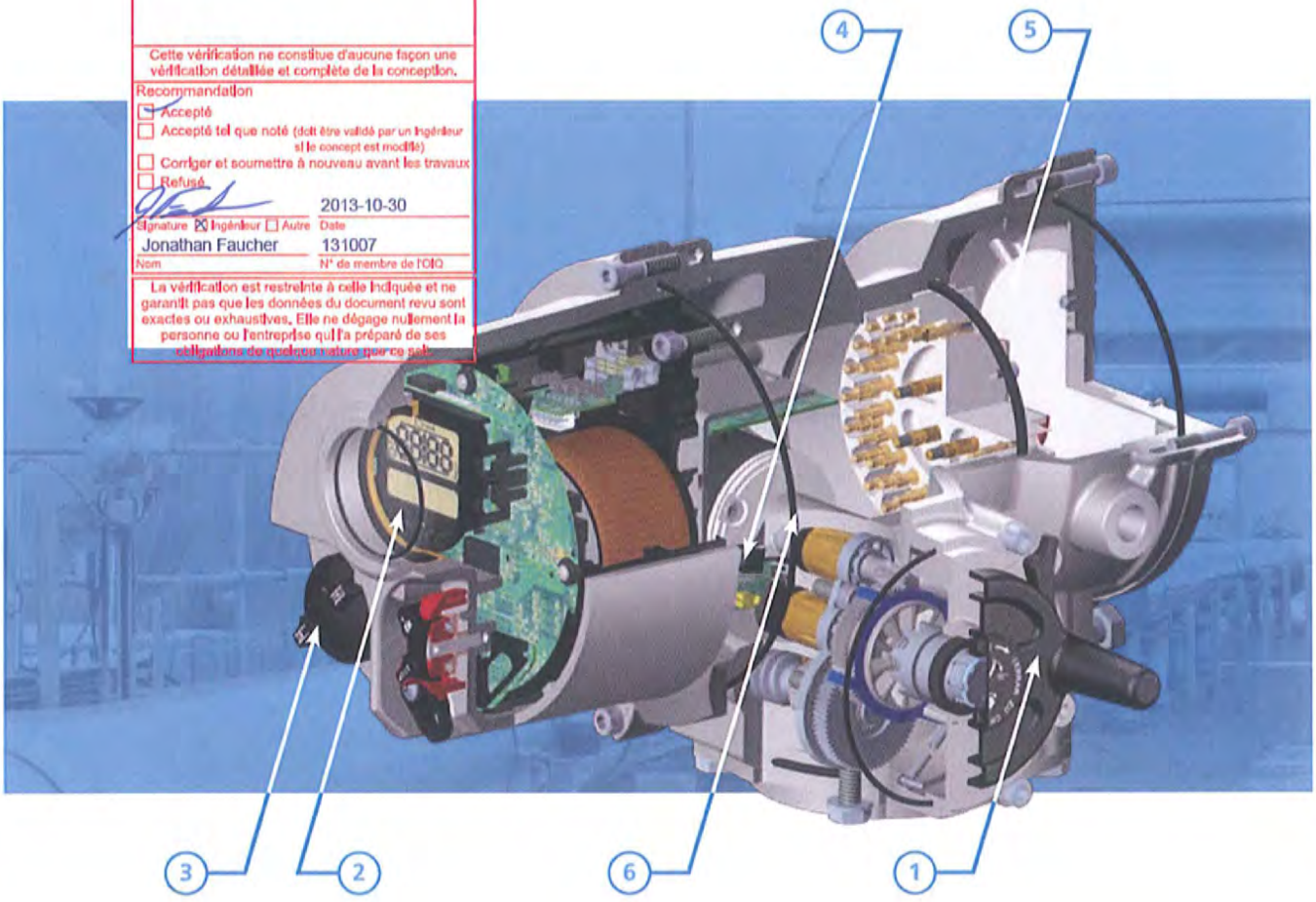



### 6 IQ motor and drive

The motor shaft and worm shaft separate to facilitate simple actuator speed change. The motor has low inertia and high torque. Peak torque is produced rapidly after starting but with very little overrun when de-energized.

The winding thermostat provides accurate temperature sensing, independent of ambient temperature conditions, to optimize the motor's thermal capacity. The motor drive includes a lost motion 'hammerblow' to assist in unseating tightly shut valves. A single worm and wheel drive run in an oil bath for maximum life with ambient temperature tolerance.

### IQT motor

This is a high efficiency compact unit with a proven reliability record in valve actuation applications over 20 years. Integrated speed control allows output speed adjustment over a 4:1 speed range.

### 7 Thrust base

Cast iron, water sealed bearings. Easily removable drive bushing for machining to suit valve stem for convenient valve adaptation.

*Minimum 6mm / ¼ inch padlock

# Design Features – Reliability

## Syncrophase prevents valve damage caused by incorrect wiring

Rotork's 'Syncrophase' automatic phase rotation correction control prevents valve damage caused by incorrect wiring by ensuring that the IQ three-phase motor is always presented with the correct phase rotation. Syncrophase senses the incoming phase rotation then energises the appropriate contactor to cause movement in the correct direction.

## Single phasing protection*

IQ *Pro* control monitors all three phases of the power supply. Should one or more phases be lost the control system inhibits operation, preventing motor "single phasing" and burn out. The actuator display will indicate "phase lost", remote indication is also available from the configurable indication contacts.

## Valve jammed protection

The actuator faces its severest operating test during unseating of the valve, when operating forces are at their highest or where an infrequently operated valve can get stuck. IQ *Pro* has the intelligence to systematically cope with these demands, ensuring reliable valve operation together with valve and actuator protection.

If valve "sticking" is considered possible, as with a wedge gate type, the torque switches can be by-passed during the first 5% of travel away from the valve seated position. This allows "extra" torque, averaging between 1.4 times and 2 times rated, to be applied in unseating the valve. In the majority of cases, applying additional force causes the sticky valve to move and allows operation to continue. After the 5% position has been reached, the torque switches return to the correct setting for the rest of travel. If this additional torque is still insufficient to cause movement IQ *Pro* recognises the valve is jammed and stops operation within seconds preventing further valve damage or motor burn out.

## IQ thermostatic protection

In the event of overheating, two thermostats embedded in the motor windings directly sense the temperature and trip the actuator control circuit.

## IQT thermostatic protection

Two thermostats are embedded within the motor power module providing comprehensive motor and motor power module protection.

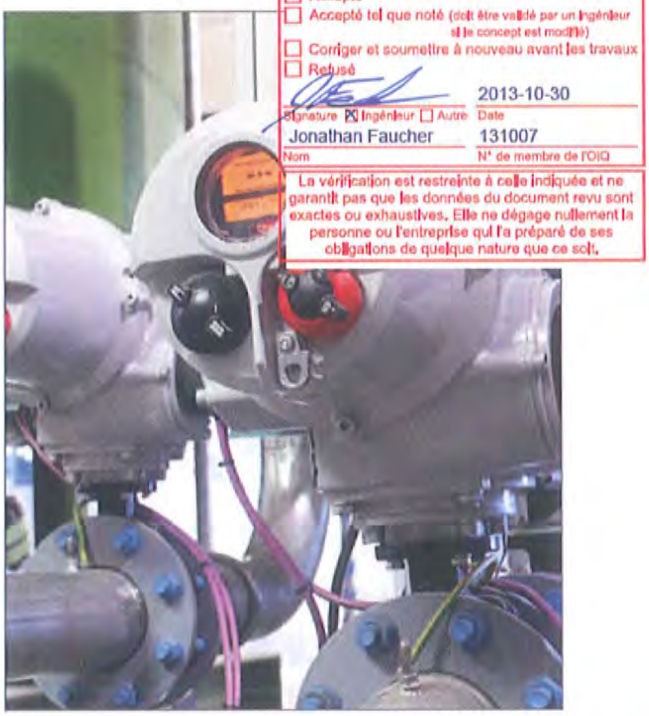
## Auto self test and diagnosis (ASTD)

Vital operational circuits automatically self test to ensure correct operation. In the unlikely event that a fault is diagnosed the information is automatically presented using the display text. At the same time, actuator operation can be inhibited to enable on-site investigation.

## Instant reversal protection

When an actuator is ordered to reverse direction 'instantaneously' an automatic time-delay circuit avoids the shock loads which may cause unnecessary wear to valve stems and gearboxes. The delay also limits current surges through the contactor.

* IQ 3 phase only.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# Design Features – Protection

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## Protection - the key

Vast experience in the application of electric actuators has enabled Rotork to set the global standard in actuator ingress protection. Actuators have to perform unfailingly in environments ranging from desert to tundra, offshore to underground, where flooding, humidity, extremes of heat and cold, ultra violet and corrosive atmospheres are the norm. Rotork understands that the most important factor in the reliability of an actuator is protection from the environment - in simple terms, the enclosure.

## Double sealed for double protection

The IQ enclosure is rated IP68 - 7 metres for 72 hours, NEMA 4/4X/6. It is completely watertight and dusttight and does not "breathe". The Rotork 'Double Seal' system ensures protection of internal components, separating them from the cable gland and terminal compartment by a watertight terminal block. Protection is maintained during site installation when terminal covers are removed and is independent of cable gland sealing.

## Non-intrusive - sealed for life

IQ covers need not be removed for site commissioning. All settings and adjustments are made using the supplied infra-red Setting Tool *Pro*, including speed setting for the IQT. After assembly in the controlled environment of our manufacturing facilities, air exchanges are eliminated - all internal components are completely protected for life. Non-intrusive control selectors mean there are no moving shafts penetrating the control enclosure.

## Reliability through simplicity

The IQ combines simplicity of design while extending specification and performance.

## Torque measurement

An actuator's ability to reliably and accurately determine the force applied in operating a valve is fundamental to providing good valve and actuator protection. The IQ range uses tried and tested technology, proven in industry. Accurate, repeatable torque measurement is achieved independent of variations in frequency, voltage and temperature.

## Position measurement

Reliable process control depends on accurate positioning of the valve throughout travel. The patented IQ non-contacting position measuring system is the most simple design devised for actuator control to date. With only one moving part, the resolver converts output centre column rotation into an electronic signal, which is then compared to position limits stored within a safe, non volatile memory.

## IQT speed control

By use of motor control technology proven in the AQ range over 20 years, the output speed of the IQT can be adjusted without affecting the torque output.

# Design Features – Intelligent Communication

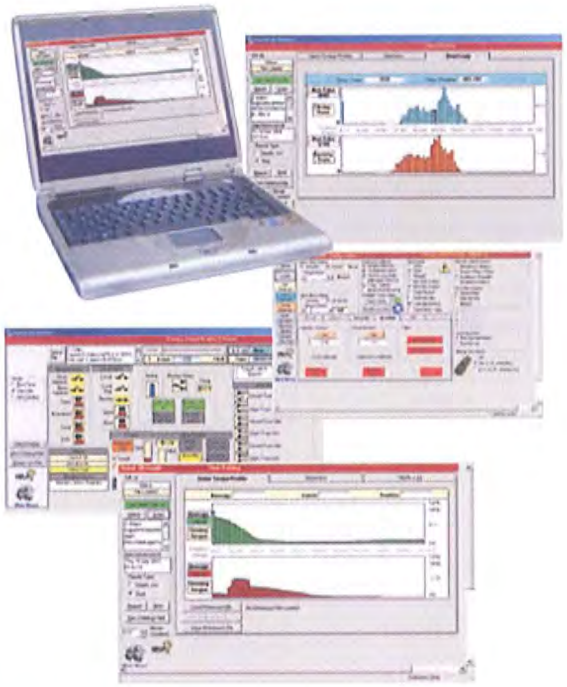
## Lifetime support

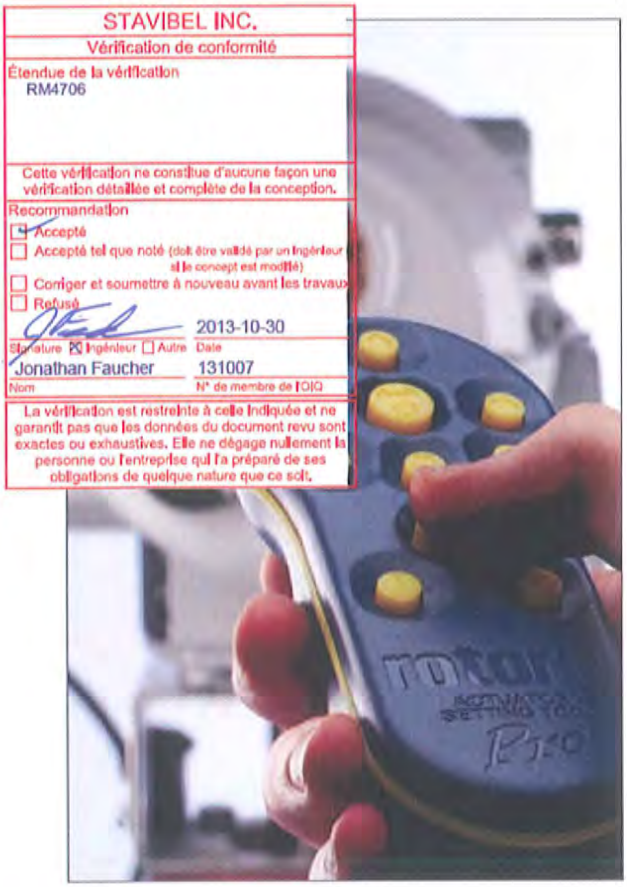
Rotork understands its customer's need for back up support. The costs and penalties of plant downtime, delayed commissioning schedules and inappropriate maintenance are too high to allow for inefficient support.

With IQ - IrDA™ (Infra-red Data Association) communication and the onboard datalogger, the IQ now offers unrivalled support to provide complete product back up with analysis and configuration. With Rotork's unrivalled worldwide service, network expert advice is always close to hand.

## Remote diagnosis - IrDA™

The IQ utilises IrDA™ communication for fast, safe, non-intrusive and standardised data exchange. Actuator set-up configuration can be analysed and, if required, changed. As every IQ includes an onboard data logger, operational data such as valve torque profiles, actuator events and statistics can be downloaded for detailed investigation. Data logger information can also be relayed to a user site base via an IrDA™ compatible PDA. After analysis, any changes to the actuator set-up configuration can be relayed back to the actuator.

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## PC tools - IQ-Insight - Pocket-Insight

IQ-Insight PC software is a graphical user interface allowing all IQ set-up configuration and data logger information to be reviewed, analysed and reconfigured. This visually interactive application is browser based, running under Microsoft or other internet browser systems.

Intuitive controls make analysing the data from an IQ simple and fast. Laptop PCs with IrDA™ interface running IQ-Insight can be directly connected to an actuator located in the field to allow set-up, adjustment and analysis.

Alternatively, data can be uploaded from the actuator and later downloaded to a PC by using a PDA running IQ Pocket-Insight freeware.

## Rotork help - online

Rotork has a comprehensive worldwide service network to provide you with local support wherever you are. Rotork trained technicians working from our network of offices and centres of excellence are available to offer immediate assistance.

To contact Rotork, visit www.rotork.com

# Design Features – Customising

**Although Rotork's standard IQ *Pro* actuator offers wide ranging control and indication flexibility, a variety of features can be customised to individual customer requirements. IQT *Pro* provides direct operation of small to medium sized quarter-turn valves up to 2,000 Nm. IQ *Pro* actuators can also be fitted with part-turn worm and wheel gearboxes to provide increased torque at reduced speeds for the operation of part-turn valves. A sizing program for both part-turn and multi-turn applications is available on the rotork website www.rotork.com**

## IQTF (full turn) actuators

For non-thrust, multi-turn, slow speed applications, the IQTF provides a reliable solution with the same general specification as the IQT range.

*For further details please contact Rotork.*

## Fireproofing and extreme cold

Fully operational at temperatures of up to +70°C, the standard IQ *Pro* range actuator can operate for up to thirty minutes in a fire (when temperatures may quickly climb to over 1,000°C)* through the use of boxes, blankets or intumescent coating, as specified by the customer.

With modifications the IQ *Pro* range actuator can also operate in temperatures as low as -50°C.

**For further details see publication S310E.*

## Floor mounting for easy remote coupling

Floor stands with upward or downward stubshafts are available for coupling to remote valves via customer shafts and universal joints.

## Linear output drive assemblies

For applications requiring an actuator with a linear output, a leadscrew arrangement can be fitted to the base of the standard IQ *Pro* actuator.

## Damper actuators

Single blade and multi vane dampers can be motorised either by direct connection to the damper spindle or by lever arm.

## Valve stem expansion

The stems of positive seating valves, such as solid or flexible wedge gates may be subject to significant expansion when used in high service temperature applications resulting in damaged or leaking valves. The effects of this expansion or contraction may be overcome by fitting the Rotork temperature compensator to the output of the IQ *Pro* actuator.

*For further details see publication E152E.*

## Rotork Site Services division

Rotork Site Services, the projects, service and retrofit division - established in 2006 - is an illustration of Rotork innovation in practice. Throughout the company's history, aftermarket services such as retrofit and maintenance have developed to support customers and reinforce Rotork's market leading position. As a result, in some countries Rotork is now the number one service supplier for valve actuation. For detailed information on Rotork Site Services see page 18.

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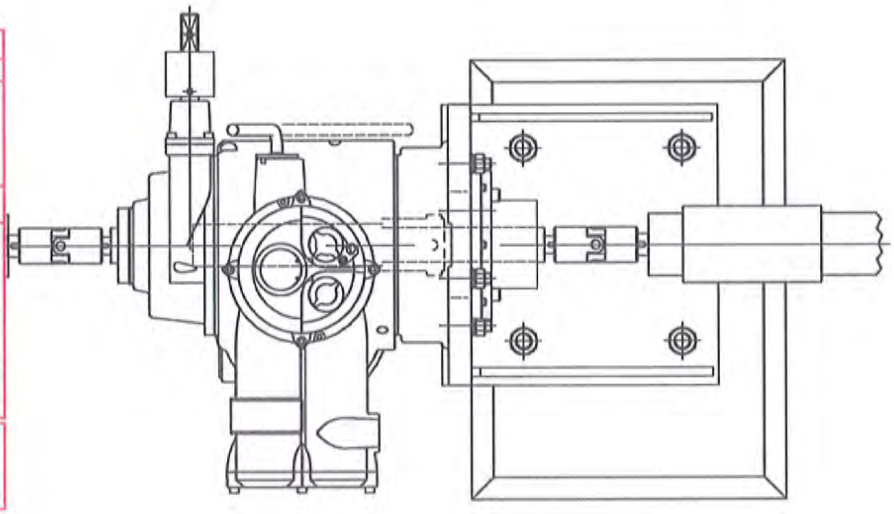

# Pakscan Bus Control System

**Integration of the plant controls by use of network connectivity has been a hallmark of Rotork actuator products for many years. The use of proprietary and open systems makes the commissioning of the plant and the subsequent control and monitoring a simple and reliable task.**

All Rotork actuators are compatible with a wide range of communication and process controls systems by including the appropriate option card during manufacture of the actuator. The actuator reports status feedback, via the field highway, to the overall plant control system (DCS or PLC) and valve control commands are actioned.

Our own Pakscan system compliments the open systems from Foundation Fieldbus, Profibus, Modbus and DeviceNet see page 16 for more details. Innovative technology together with expert bus system knowledge ensures that Rotork can always provide the ideal solution for the control system.

## Rotork Pakscan - the total control solution

Whether you need remote control of a few motorised valves, or full automation of a complex plant, Pakscan can help you to achieve significant savings in both time and costs.

Pakscan allows the remote control of actuators and valves over a simple single twisted pair data highway, removing the need for heavy multicore cables. It also includes automatic inbuilt redundancy of the field network to ensure control will be maintained even in the event of equipment or cable failure.

Available as a single or hot standby master station variant, Pakscan has the ability to control up to 240 actuators, and other field devices, using secure field communications. The field data highway cable may be up to 20 km in length so even quite distant valves can easily be incorporated into the network, without the need for repeaters.

Simple to install and simple to use, the highly successful Pakscan system has proved its value on many varied sites with over 70,000 Pakscan actuators installed worldwide.

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☐ Accepté tel que noté (doit être validé par un ingénieur si le concept est modifié)
☐ Corriger et soumettre à nouveau avant les travaux
☐ Refusé
2013-10-30
Signature ☒ Ingénieur ☐ Autre — Date
Jonathan Faucher — 131007
Nom — N° de membre de l'OIQ
La vérification est restreinte à celle indiquée et ne garantit pas que les données du document revu sont exactes ou exhaustives. Elle ne dégage nullement la personne ou l'entreprise qui l'a préparé de ses obligations de quelque nature que ce soit.